

DOCUMENT RESUME

ED 281 146

CS 008 745

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TITLE Cost-Benefit Analysis for 1985-86 ECIA Chapter 1 and State DPPF Programs Comparing Groups Receiving Regular Program Instruction and Groups Receiving Computer Assisted Instruction/Computer Management System (CAI/CMS).
INSTITUTION Columbus Public Schools, OH. Dept. of Evaluation Services.
PUB DATE 17 Dec 86
NOTE 11p.
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Attendance; Comparative Analysis; *Computer Assisted Instruction; Computer Managed Instruction; *Cost Effectiveness; Elementary Secondary Education; Enrollment; Program Costs; *Program Evaluation; Reading Achievement; Reading Instruction; *Reading Programs; Reading Research; *Remedial Reading; *Teaching Methods
IDENTIFIERS Education Consolidation Improvement Act Chapter 1

ABSTRACT

To determine the effectiveness of the computer assisted instruction/computer management system (CAI/CMS) as an alternative to conventional methods of compensatory reading instruction, a cost benefit study evaluated elementary, middle, and high school reading programs in the Columbus, Ohio, school district. Analysis was based on cost outlay for the computer laboratory, teachers, and aides, and comparisons between CAI/CMS units and conventional laboratories were carried out in terms of enrollment, attendance, and achievement. The overall program cost and cost per pupil were calculated according to the number of pupils in the program and pupils per teacher. Among the major findings were the following: (1) the cost per pupil was greater in the CAI/CMS groups than in the regular groups at all three grade levels; (2) normal curve equivalence gains were nearly the same for the regular and CAI/CMS groups at the elementary level, though this situation was substantially reversed at the middle school level; and (3) more pupils per teacher were served in the CAI/CMS groups than in the regular groups, particularly at the elementary level. Based on these findings, it was recommended that only the middle school CAI/CMS program be continued and that the others be further evaluated. (Statistical data detailing cost-benefit analysis base figures and comparisons are included.) (JD)

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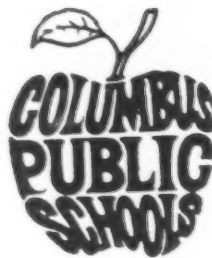
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Introduction

The Columbus Public Schools' Title I/Chapter 1 programs have been in operation since 1968. Many of the materials and equipment were purchased in the early years of the program. The cost of replacing worn-out, lost, or stolen equipment and updating materials would be very costly. There was also the necessity of increasing the number of pupils served with the same number of instructional staff. As a solution to the problems that were facing compensatory education administrators, computer reading laboratories were leased in order to alleviate equipment, materials, and enrollment problems. There was also a desire of program administrators to demonstrate that computer assisted instruction/computer management system (CAI/CMS) was effective in compensatory education classrooms. The use of computers was a departure from the conventional reading laboratory.

A cost benefit study was conducted to determine the effectiveness of the computer assisted instruction as an alternative to the conventional method of teaching reading. Analysis was based on cost outlay for the computer laboratory, teachers, and aides. Comparative analysis between CAI/CMS units and conventional laboratories was done in terms of enrollment, attendance, and achievement. The following pages describe the methodology and rationale in doing the analysis as well as the findings. Summary and Recommendations are included.

Base Figures for Cost Analysis

Average salary plus fringes for DFSP Teachers

Elementary	36,373.65
Middle School	35,338.02
High School	35,310.97
Elementary and Middle School Aides (Maximum)	11,079.65

Contract costs for Prescription Learning (PL) Company- elementary and high school

Elementary	532,200.00
High School	175,900.00
Total Contract Cost PL Company	708,100.00

Contract Costs for Time Share Corporation (TSC) - middle school

Three-year lease/purchase of 6 Dolphin computers, terminals and cables (third year payment)	77,132.00
Maintenance for period of 9/1/85-8/31/86 on the above	39,690.00
License of TSC's Dolphin Reading and Language Arts Software	20,020.00
	136,842.00

Normal supplies and incidental costs were not known in regard to the separate program subcomponents, but were assumed to be evenly distributed across program subcomponents.

Program Costs

CLEAR, Regular program (units serving grades 4-5 in public schools)

10.9 Teachers*	@ 36,373.65	396,472.79
Total program cost		396,472.79
Number of teachers		10.9
Cost per teacher unit		36,373.65

* Eight teachers in the Regular program served grades 4-5 exclusively. The equivalent of an additional 2.9 teachers was computed based on the proportion of fourth and fifth grade pupils in seven additional classrooms which also served the lower grades:

CLEAR-CAI (grades 4-5 with CAI/CMS)

27 Teachers	@ 36,373.65	982,088.55
27 Aides (full year)	@ 11,079.65	299,150.55
PL Contract Cost (total for elementary)		<u>532,200.00</u>

Total program cost	1,813,439.10
Number of teachers	27
Cost per teacher unit	67,164.41

CLEAR, Regular program (grades 6-8)

21 Teachers	@ 35,338.02	742,098.42
Total program cost		742,098.42
Number of teachers		21
Cost per teacher unit		35,338.02

CLEAR-Dolphin (grades 6-8 with CAI/CMS)

7 Teachers	@ 35,338.02	247,366.14
6 Aides	@ 11,079.65	66,477.90
TSC Contract Cost (Total)		<u>136,842.00</u>
Total program cost		450,686.04
Number of teachers		7
Cost per teacher unit		64,383.72

SDR, Regular program (grades 9-10)

6 Teachers	@ 35,310.97	211,865.82
	Total program cost	211,865.82
	Number of teachers	6
	Cost per teacher unit	35,310.97

SDR-PL (grades 9-10 with CAI/CMS)

9 Teachers	@ 35,310.97	317,798.73
PL Contract Cost (Total for high school)		<u>175,900.00</u>
	Total program cost	493,698.73
	Number of teachers	9
	Cost per teacher unit	54,855.41

Table 1

Cost-Benefit Analysis for 1985-86 ECIA Chapter 1 and State DPPF Programs Comparing Groups Receiving Regular Program Instruction and Groups Receiving Computer Assisted Instruction/Computer Management System (CAI/CMS)

Program	Number of Teachers	Program Cost		Pupils in Program			Pupils per Teacher			Cost per Pupil			Ratio of Sample to Pupils Served	Average NCE Gain
		Total	Per Teacher	Served	In Sample	Average Daily Membership	Served	In Sample	Average Daily Membership	Served	In Sample	Average Daily Membership		
CLEAR grades 4-5 (Regular group)	10.9	396,472.79	36,373.65	578	392	491.4	53.0	36.0	45.1	685.94	1011.41	806.82	67.8%	4.2
CLEAR-CAI (grades 4-5 with CAI/CMS)	27	1,813,439.10	67,164.41	1772	1154	1523.3	65.6	42.7	56.4	1023.39	1571.44	1190.47	65.1%	4.1
CLEAR grades 6-8 (Regular group)	21	742,098.42	35,338.02	1106	620	920.9	52.7	29.5	43.9	670.98	1196.93	805.84	56.1%	4.9
CLEAR Dolphin (Grades 6-8 with CAI/CMS)	7	450,686.04	64,383.72	414	214	341.2	59.1	30.6	48.7	1088.61	2106.01	1320.89	51.7%	6.3
SDR grades 9-10 (Regular group)	6	211,865.82	35,310.97	340	163	300.6	56.7	27.2	50.1	623.13	1299.79	704.81	47.9%	-6.1
SDR-PL (Grades 9-10 with CAI/CMS)	9	493,698.73	54,855.41	569	304	499.0	63.2	33.8	55.4	867.66	1624.01	989.38	53.4%	-9.8

Highlights of Cost-Benefit Analysis Table

The truest "cost per pupil" figures reported in Table 1 would be those based on Average Daily Membership. On that basis the following will be noted:

1. At the elementary level (grades 4-5) the cost per pupil is \$383.65 more for the CAI/CMS group than for the Regular group.
2. At the middle school level (grades 6-8) the cost per pupil is \$515.05 higher for the CAI/CMS group than for the Regular group. It should be noted, however, that a large portion of the TSC contract costs was comprised of the final payment to a three-year lease/purchase arrangement.
3. At the high school level (grades 9-10) the cost per pupil is \$284.57 higher for the CAI/CMS group than for the Regular group.

When average NCE gains are compared, the following will be noted:

1. Average NCE gains in grades 4-5 are nearly the same in the Regular and CAI/CMS groups, with the Regular group exceeding the CAI/CMS group by only one tenth of an NCE.
2. Average NCE gains at the middle school level are 1.4 NCE's higher in the CAI/CMS group than in the Regular group.
3. At the high school level, both groups made negative changes. The negative change was somewhat less severe in the Regular group, being -6.1, as compared to -9.8 in the CAI/CMS group.

More pupils were served per teacher in the CAI/CMS groups than in the regular groups. This was especially noteable at the elementary level, where the Average Daily Membership was 11.3 per teacher more in the CAI/CMS group than in the regular group. The difference in Average Daily Membership per teacher at the middle school level was 4.8 more pupils in the CAI/CMS group than in the regular group. The high school CAI/CMS group served an average daily membership of 5.3 pupils per teacher more than did the regular high school group.

Another factor which might be considered is the number of pupils served who qualify for inclusion in the evaluation sample. To qualify for the sample, a pupil must have attended at least 80% of the program days and received both a pretest and a posttest. A small number of the pupils were also excluded from the sample on the basis of being non-English speaking. Therefore, the percent of pupils served who are included in the evaluation sample is not a strict index of attendance alone but gives a rough indication of attendance confounded by other factors. When the ratio of pupils in the sample to total pupils served is examined, the following are noted:

1. The ratio is slightly higher for the Regular group than for the CAI/CMS group at the elementary level (2.7% higher).
2. At the middle school level, the ratio is 4.4% higher for the Regular group than for the CAI/CMS group.
3. At the high school level, the ratio is 5.5% higher for the CAI/CMS group than for the regular group.

Separate data are also available on the number of pupils who met the 80% attendance criterion without regard to other factors in sample inclusion. These data are summarized in Table 2. The percent of pupils attaining the attendance criterion was 3.5% greater for the Regular group than for the CAI/CMS group in grades 4-5, and 3.5% greater for the Regular group than for the CAI/CMS group at the middle school level. In high school, however, the CAI/CMS group surpassed the Regular group by 6.6%.

Table 2

Comparison of Regular and CAI/CMS Groups
of ECIA Chapter 1 and State DPPF Programs
in Regard to Attainment of the Attendance Criterion

Program	Pupils Served	Pupils Attaining Attendance Criterion	
		Number	Percent
CLEAR Grades 4-5 (Regular group)	578	426	73.7%
CLEAR-PL (Grades 4-5 with CAI/CMS)	1772	1244	70.2%
CLEAR Grades 6-8 (Regular group)	1106	688	62.2%
CLEAR Dolphin (Grades 6-8 with CAI/CMS)	414	243	58.7%
SDR Grades 9-10 (Regular group)	340	195	57.4%
SDR-PL (Grades 9-10 with CAI/CMS)	569	364	64.0%

Summary

The cost per pupil was greater in the CAI/CMS groups than in the regular groups at all three levels.

Comparison of NCE gains varied according to school level. At the elementary level, NCE gains were nearly the same for Regular and CAI/CMS groups, with a difference of only one tenth of an NCE. At the middle school level, the CAI/CMS group surpassed the Regular group by 1.4 NCE's. There was negative change in both groups at the high school level, but there was a difference of 3.7 NCE's in favor of the Regular group.

More pupils were served per teacher in the CAI/CMS groups than in the regular groups. This was especially true at the elementary level. Based on Average Daily Membership, the number of pupils per teacher in CAI/CMS groups exceeded the number of pupils per teacher in Regular groups as follows: 11.3 in grades 4-5, 4.8 in middle school, and 5.3 in high school.

In comparing the percent of pupils attaining the program attendance criterion, data indicated that the elementary Regular group surpassed the CAI/CMS elementary group by 3.5%, that the middle school Regular group surpassed the CAI/CMS middle school group by 3.5%, and that the high school CAI/CMS group surpassed the Regular high school group by 6.6%.

Recommendations

The recommendations are:

1. Continue to evaluate the CAI/CMS part of the program with an eye toward finding more effective methods of serving pupils who are experiencing reading problems. Further expansion of the CAI/CMS project is not warranted at this time.
2. Review program content, program activities, and test content to determine why pupils are not showing desired growth.
3. The only level at which the CAI/CMS group surpassed the Regular group this year was at the middle school level. It should also be noted that future use of the Dolphin computers used at this level is likely to be more cost effective, since a large portion of the cost in this year's program was the final payment on a three year purchase agreement. Therefore, continuation of the middle school CAI/CMS program appears to be justified.